Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D. C. 20554

In the Matter of	)	
	)	
Redevelopment of Spectrum to	)	ET Docket No. 92-9
Encourage Innovation in the	)	
Use of New Telecommunications	)	RM-7981
Technologies	)	RM-8004

To: The Commission

Motion to Accept Late-Filed Comments of Apple Computer, Inc.

Apple Computer, Inc. ("Apple"), pursuant to Section 1.46 of the Commission's Rules, respectfully requests that its attached Reply Comments in the above-captioned matter be made a part of the record, even though its submission is being filed one business day after the February 12, 1993, deadline. The delay was caused by an unavoidable last-minute problem in transmitting the final Reply from Apple's offices in California to the undersigned.

Unlicensed personal communications services hold great significance for Apple. Apple's Reply focuses on issues of importance that are unlikely to be addressed in full by other commenting parties. Apple's Reply, therefore, will provide the Commission with a more complete record, and the brief delay in submitting these comments will not prejudice the interests of other parties.

For these reasons, Apple asks that the Commission grant this motion for late filing of its Reply Comments.

Respectfully submitted,

Apple Computer, Inc.

By: Henry Goldberg

GOLDBERG, GODLES, WIENER & WRIGHT
1229 19th Street, N.W.
Washington, D.C. 20036
(202) 429-4900

Its Attorney

February 16, 1993

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D. C. 20554

In the Matter of	)	
	)	
Redevelopment of Spectrum to	)	ET Docket No. 92-9
Encourage Innovation in the	)	
Use of New Telecommunications	)	RM-7981
Technologies	)	RM-8004

To: The Commission

Reply Comments of Apple Computer, Inc.

James F. Lovette
APPLE COMPUTER, INC.

One Infinite Loop, MS : 301-4J
Cupertino, California 95014
(408) 974-1418

Henry Goldberg
GOLDBERG, GODLES, WIENER & WRIGHT

1229 19th Street, N.W.
Washington, D.C. 20036
(202) 429-4900

OF COUNSEL

February 12, 1993

SUMMARY

While this and related proceedings have demonstrated the significant demand for, and benefits of, unlicensed PCS, several aspects of the Commission's proposed plan for allocating spectrum to this service threaten to prevent the development of User-PCS in the United States.

The current 20 MHz allocation is inadequate to meet the long-term spectrum needs of unlicensed PCS. Moreover, the Commission's plan to permit public safety licensees to remain in the unlicensed band will make it impossible to clear this band of microwave users, an absolute precondition for the development of unlicensed PCS. Finally, the extended voluntary and involuntary relocation processes recommended by the Commission will delay the deployment of unlicensed PCS, undermining incentives for manufacturers to make the significant investments in this technology that will be necessary for it to develop.

If the Commission is to achieve its stated goal of fostering unlicensed PCS, it must take several steps: it must allocate additional frequencies for this service, require public safety users to relocate and work with NTIA to provide them with immediate access to the 1.7 GHz government bands, reject calls for a transition period or extended negotiation period for the unlicensed band, and adopt an affordable and timely phased relocation plan that relies upon frequency optimization and the use of reserve bands.

TABLE OF CONTENTS

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D. C. 20554

In the Matter of	)	
	)	
Redevelopment of Spectrum to	)	ET Docket No. 92-9
Encourage Innovation in the	)	
Use of New Telecommunications	)	RM-7981
Technologies	)	RM-8004

To: The Commission

Reply Comments of Apple Computer, Inc.

Apple Computer, Inc. ("Apple"), hereby submits reply comments on the First Report and Order and Third Notice of Proposed Rule Making ("Third NPRM") in the above-referenced proceeding.

I. Introduction.

The Commission will find no difficulty extracting from the voluminous record assembled in this and related proceedings a compelling message supporting unlicensed "User-PCS."[1] The other compelling message delivered by the record is that User-PCS may never be developed in this country.

If User-PCS is to develop as a viable service, it must be allocated an adequate amount of frequencies completely cleared of fixed microwave stations as soon as possible. The record in this and related PCS and emerging technology proceedings demonstrates that:

- the amount of spectrum allocated to unlicensed technologies is inadequate by some 20 to 45 MHz; even this larger amount

---

[1] Apple uses the term "unlicensed" to refer to classes of products that will be sold to the general public without regard to, or control of, where they will be used and without individual licenses. In this context, frequency coordination is a practical impossibility and unlicensed devices, under Part 15 of the FCC's Rules, are not subject to *a priori* restrictions upon operation other than those defined through the equipment authorization process.

may not be adequate if there is a wholesale shift of carrier-type services to the unlicensed bands, when licensing delays and failures drive would-be PCS licensees to the unlicensed frequencies;

- the unlicensed frequencies never will be cleared of fixed microwave stations unless the FCC retraces its steps and requires public safety microwave licensees to be relocated when their channel assignments are needed for unlicensed PCS technologies; and

- development of a technically appropriate "home" at 6 GHz for dislocated microwave users, "transition periods," negotiation periods, construction of new microwave links, testing of "comparable facilities," plus the sheer cost of paying for the relocation to 6 GHz, all will combine to pile delay upon delay in introducing unlicensed PCS technologies, delays which, as the Commission has been advised time and again, will kill new technologies in the lab.

If the Commission is to make good on its determination to foster the growth of new technologies using 2 GHz frequencies, a better approach must be found. At least for the unlicensed frequencies that Apple first came forward to secure, that approach involves the following steps:

- allocating additional frequencies for unlicensed technologies;

- requiring public safety microwave users to relocate;

- working with NTIA to provide immediate access to the 1710-1850 MHz federal government bands for displaced public safety microwave users;

- rejecting calls for a transition period, or an extended negotiation period, prior to relocating microwave stations from the unlicensed frequencies; and

- adopting an affordable and timely-phased relocation plan that relies upon the optimization of existing 2 GHz microwave assignments and the use of reserve bands in both the unlicensed and licensed PCS frequencies.

The frequency optimization methodology suggested by Apple[2] is one of the few tools that embodies a high confidence that both the exacting reliability requirements of present microwave users and the urgent timetables sought for the new technologies can be achieved. In the brief discussion below, Apple provides further detail on these issues.

II. The Commission Should Require The Immediate Clearing Of The Unlicensed Band.

A. Failure To Clear The Unlicensed Frequencies Will Have A Significant And Perhaps Irreversible Negative Effect On The Development Of Unlicensed PCS.

Unlicensed PCS, which will — among other things — provide access to the National Information Infrastructure[3] for the ordinary citizen, requires no government subsidy, no assignment of tax revenue, and no action by the Congress. The costs will be borne by companies investing directly in developing and manufacturing the necessary hardware and software, and by those purchasing these resources for their own benefit.

However, Apple and other companies that have been planning innovative unlicensed PCS technologies, such as Data-PCS, will not proceed with their plans in the face of an uncertain operating environment, or even in the face of long delays in gaining access to unencumbered frequencies. Programs will be canceled. The investment required to develop and market unlicensed PCS products and services will not — indeed, should not — be made without some likelihood of return on that investment.[4]

---

2 See Section III(A), infra.

3 See Comments of Apple Computer, Inc., ET Docket 92-9, at 2-4 (filed Jan. 13, 1993).

4 Even if some companies would make a limited investment, consumers will not buy products under imminent threat of recall, or where their use is subject to a high probability of interference from incumbent microwave licensees and the requirement that they immediately cease operation

Without that investment commitment, U.S. leadership in the development of unlicensed PCS (and with it, in the development of the National Information Infrastructure, international PCS standard setting, and PCS product development and manufacturing) simply will come to a halt.

B. Clearing Must Be Immediate And Must Include Public Safety Licensees.

There is virtual unanimity that unlicensed PCS services cannot share spectrum with microwave facilities, including public safety stations. Sharing presents insurmountable problems for both microwave users and unlicensed PCS users; it is in neither's interest to operate in a shared band. No wishful hoping for coexistence will change the technical realities. Frequencies must be cleared nationwide prior to the general deployment of even the first such unlicensed device.[5]

As long as even one portable unlicensed PCS device can show up in the vicinity of a microwave link, the threat of interference exists. The only time the threat disappears is when the "last link" has been cleared from the unlicensed band, permanently and without recourse. The Commission appears to have recognized this "last link" phenomenon when it chose relatively lightly-loaded microwave bands for reallocation to the unlicensed technologies, and intimated that there should be no transition period in the unlicensed band. With respect to public safety microwave users, however, the Commission has created a paradox.

Allowing public safety users to continue using their existing 2 GHz frequencies dictates one of two outcomes: either these users will be subjected to interference from unlicensed services or the unlicensed services will not be able to be deployed. Since one cannot assume that the Commission will tolerate

---

if they cause interference to microwave systems — as many quite likely will if the unlicensed bands are not cleared. See 47 C.F.R. 15.5.

[5] Despite this reality, Apple supports the adoption of provisions to promote the early deployment of devices, both to permit the services to be developed and to commence a revenue stream to help finance microwave relocation. The Commission should adopt procedures to permit the initial deployment of selected services that could, after band-clearing, best be carried forward on an unlicensed basis, in bands set aside for unlicensed uses, with limited delegation of responsibility for frequency coordination to an industry organization established for that purpose. Any deployment of any service in the future unlicensed bands should conform to the ultimate usage of those bands.

interference to public safety users, it appears that the Commission intends to stifle the development of the unlicensed services. Yet the Commission, as well as the record in this proceeding, has made clear that there is overwhelming support for, and great promise in, the development of unlicensed services.

If unlicensed PCS services are to develop, the Commission must choose an alternative method for addressing the special needs of public safety users.

C. Public Safety Users Should Be Given Priority Access To The Government Bands.

By far the most problematic of the risks associated with relocation is uncertainty about the comparative reliability of 6 GHz links.[6] In view of the critical nature of the public safety links, these users should be given priority access to the federal government bands at 1710-1850 MHz until their needs, including plans for system modifications (but not wholesale expansion), have been accommodated.

NTIA has characterized the 1710-1850 MHz band as "the predominant federal medium capacity, line of sight, fixed service band."[7] It is well demonstrated that fixed links in this band can be frequency coordinated. It should be entirely possible, therefore, to optimize coordination so that the approximately 4840 fixed service frequency assignments currently in this band[8] would not be affected by the addition of the several hundred public safety microwave stations that would have to be relocated to create an unlicensed band of 40 to 65 MHz. Moreover, the relocation of public safety users would not require the wholesale transfer of a large frequency block from NTIA to the FCC; rather, it would entail the case-by-case allocation of specific frequencies at specific locales to specific microwave operators. In a large number of cases, the

---

6 Indeed, the Commission has recommended a one-year proving-in period for each 6 GHz replacement link before a station can be deemed permanently "cleared" from its former 2 GHz channel. This validation exercise far exceeds the pre-acceptance burden of proving performance for other new links, and many would find it excessive. Whether or not the one-year period is excessive, its direct effect will be to forestall deployment of unlicensed devices further — adding yet another year added to an already overly long timetable.

7 See Federal Spectrum Usage of the 1710-1850 and 220-2290 MHz Bands, NTIA Report 92-285, at 4-1 (Mar. 1992).

8 Id. at 4-3.

relocation of public safety users could be accomplished using current practices employed in the government band to assure interference protection.[9]

III. The Commission Should Adopt A Phased Relocation Plan That Relies Upon Optimization Of 2 GHz Microwave Assignments And The Use Of Reserve Bands In Both The Unlicensed And Licensed PCS Frequency Bands.

A. Apple's Proposed Frequency Optimization Plan.

While it will be necessary to relocate incumbent licensees to accommodate PCS and other emerging technologies, the Commission should consider ways of reducing the burdens associated with this task. Apple has developed a frequency optimization approach that offers this benefit.

When microwave stations are initially licensed, it is impossible to allocate frequencies to individual paths in a manner that ensures optimal frequency use. It has been reported in detail that the fixed microwave band is presently being used in only a tiny percentage of the nation's landmass, and that even in areas of high population and microwave station density there are large amounts of spectrum lying fallow. Those unused channels, however, follow no pattern across the land; that is, while substantial portions of the band remain unoccupied, they are not the same portions at all locations.

The possibility of retuning microwave stations to gain better band utilization, and to reconfigure band usage so that nationwide consistency can be achieved, has been suggested previously. Indeed, this approach has been relatively common in "optimizing" TV and radio broadcast stations using geographic and frequency coordination. More recently, Germany has freed spectrum for nationwide cellular services by applying such measures to fixed microwave services.

---

[9] Apple notes that legislation currently pending before the Senate would exempt public safety services -- as well as any other licensee being moved from its current frequency assignment by the FCC in order to implement the goals of the Emerging Telecommunications Technologies Act of 1993 -- from the proposed competitive bidding process. "Emerging Telecommunications Technologies Act of 1993," S. 335, §8(b) (103rd Cong., 1st Sess.) (introduced Feb. 4, 1993) (proposed new sections 42 U.S.C. §§ 309(j)(4)(C), 309(j)(4)(E)).

Until now, however, no systematic methodology for such frequency optimization had been developed, at least in part because doing so is computationally complex and requires one to rely upon data bases that are incomplete and were not assembled for this purpose. Indeed, until the FCC proposed to allocate 2 GHz fixed microwave frequencies for PCS (and especially unlicensed PCS) without also explicitly providing a suitable band-clearing process, there had been no urgency in applying state-of-the-art spectrum efficiency techniques in the fixed microwave band. Moreover, frequency optimization can be performed only after the requirements of each of the stations in a given service area (including the required sites for receivers and transmitters) are known, as well as the goals of the optimization and the constraints on the optimization process.

These conditions now exist with respect to the 1850-1990 MHz band. There is a fixed universe of existing licensees, as well as a defined alternative use for any cleared frequencies. Recognizing the difficulties posed by relying solely on migration to the 6 GHz band, Apple recently began to study the practicality of in-band frequency optimization, and the prospects of using this approach to make spectrum more quickly available for Data-PCS and other unlicensed PCS applications. Apple submits that, by modifying the frequencies used by incumbent licensees in a manner that effectively and efficiently employs each available frequency (staying, however, within the current band), the Commission could effectively "create" new clear frequencies without requiring immediate relocation to the 6 GHz band. Appendix A, attached hereto, illustrates the benefits that could be achieved by employing such a frequency optimization process.

Appendix A first briefly reviews the conclusions reached by Cox Enterprises, Inc. in a study of spectrum utilization in the 1850-1990 MHz band in the San Diego Metropolitan area, prepared by Comsearch and filed with Cox's Reply Comments in GEN Docket No. 90-314. The Cox study finds that it is impossible to accommodate PCS services in many areas of the country, where the proposed PCS spectrum is already crowded with existing microwave users. As Cox stated, its study "reveals numerous critical, high demand areas that PCS providers would be blocked from providing service. . . . There is simply not enough underutilized spectrum in the 1850-1990 MHz band to permit PCS

providers to serve critical areas within their licensed markets without significant relocation of existing users."[10] Based upon these findings, Cox concluded that PCS licensees must be provided a 40 MHz minimum spectrum allocation per licensee, with access to a spectrum reserve.[11]

As Appendix A makes clear, however, this not the only conclusion one can draw from Cox's findings. When Apple studied the San Diego Metropolitan area using a spectrum optimization methodology proposed by Apple and developed by the telecommunications consulting firm of Rubin, Bednarek and Associates, it found that the existing microwave paths could be accommodated in 90 MHz of spectrum, freeing 50 MHz completely for allocation to other users. Moreover, four paths were identified that each individually blocked a different 10 MHz path. By moving these four paths, an additional 40 MHz could be cleared. Similar possibilities were found in four other market areas studied by Apple. Apple notes that its methodology provides for clearing the same frequencies nationwide, minimizing the need for PCS providers to implement costly and complex "avoidance" schemes.

Thus, a frequency optimization plan could be employed to clear substantial amounts of spectrum within the 1850-1990 band. While Apple is not advocating use of this approach to eliminate the need for incumbent licensees to migrate to the 6 GHz band, it could be employed as a later (or even last) resort for stations not able to relocate to 6 GHz in a timely fashion. In this way, the Commission could speed the relocation process, reduce the burdens on selected incumbent licensees, and avoid making PCS spectrum allocations that are larger than otherwise necessary because of spectrum-sharing requirements.

---

[10] Comments of Cox Enterprises, Inc., ET Docket No. 92-9, p. 4-5 (filed Jan. 13, 1993).

[11] Reply Comments of Cox Enterprises, Inc., GEN Docket No. 90-314, at 3 (filed Jan. 8, 1993). Apple has previously stated its view that, rather than in effect encouraging the inefficient use of the PCS spectrum by licensing PCS providers to 40 MHz in order to enable them to co-exist with fixed microwave users, the Commission should focus its efforts on creating an effective means of clearing frequencies so that the full range of frequencies assigned to a PCS licensee can be employed. Reply Comments of Apple Computer, Inc., GEN Docket 90-314, at 8 (filed Jan. 11, 1993).

B. Phased Relocation With Reserve Bands.

In order to speed the relocation process further and thereby promote the timely implementation of PCS services, the Commission should also adopt the following phased relocation plan for both the unlicensed and licensed PCS frequency bands.

a. Phase One

1. Clear the 1910-1930 MHz band immediately for unlicensed PCS by allowing any users who are prepared to move immediately to 6 GHz and public safety users who are prepared to move to government frequencies to do so. Implement the relocation process for such users (including paying relocation costs). If government frequencies are not available for particular public safety users, give such users priority access to frequencies in the unlicensed and licensed reserve bands.

2. Begin implementing a frequency optimization plan in the unlicensed and licensed PCS bands, as discussed above.

3. Identify a 20 to 30 MHz reserve for unlicensed PCS, in addition to the primary 1910-1930 MHz unlicensed band. (Apple suggests using the 1890-1910 MHz and 1980-1990 MHz bands.)

4. Identify primary and secondary channels within the allocations for each PCS licensee. The designated primary channels (e.g., 20 MHz) should contain sufficient bandwidth to establish service. Designate the balance of the allocation(s) as a PCS reserve, which may be used to accommodate microwave stations where needed.[12]

---

[12] Apple notes that there is no downside potential — and significant upside potential — to designating a reserve band for unlicensed and licensed PCS services. If these services do not develop as predicted, the Commission can re-allocate the reserved frequencies to other uses, or permit incumbent microwave users to continue operating in the reserve frequencies. If these services do develop, the Commission will be able promptly to provide new licensees with additional 20 MHz allocations or permit existing licensees to expand their service.

5. Allow any microwave licensees in the primary licensed-PCS channels willing to move immediately to 6 GHz and public safety users who are prepared to move to government frequencies to do so. Implement the relocation process for such users (including paying relocation costs). If government frequencies are not available for particular public safety users, give such users priority access to frequencies in the unlicensed and licensed reserve bands.

6. Generate a master frequency optimization plan for retuning the remaining stations, first into the unlicensed reserve bands, and then into the licensed reserve bands. This process will identify key stations not technically able to retune within the band.

7. As to any station in either the unlicensed or licensed bands that cannot practically be accommodated within the reserve bands and has not chosen to move to the 6 GHz band, begin the involuntary relocation process immediately in accordance with the involuntary relocation guidelines of the Commission.[13]

b. Phase Two

1. As the development of unlicensed PCS dictates, clear the remainder of the unlicensed PCS band by moving the stations in the unlicensed reserve to 6 GHz or to alternate media, in order to permit full deployment of unlicensed devices on a nationwide basis.

2. Clear the licensed PCS secondary channels on a selective basis (where needed to respond to market demand). A large proportion of the links,

---

[13] Apple believes that the number of stations requiring involuntary relocation to 6 GHz under this proposal will be only a small proportion of the total. With the task thus reduced, financial resources adequate to do the job in a timely fashion will be found. Apple notes that, as several commenters made clear, the Commission's extensive protections for incumbent users — which provide that no incumbent may be involuntarily relocated until new facilities have been constructed and tested — make it unnecessary to adopt an initial "voluntary" relocation period. Such a period will delay the deployment of PCS services without providing any necessary additional protection to incumbent licensees, and will give incumbents the power to force PCS providers to pay a premium for prompt access to spectrum.

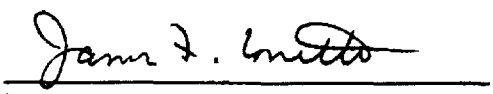
particularly in non-metropolitan areas, are likely to remain in these secondary channel locations indefinitely.

CONCLUSION

In this and related proceedings, the Commission has taken important steps toward ensuring that the public will be able to enjoy the substantial benefits associated with unlicensed PCS and other emerging technologies. As discussed in these Reply Comments, however, the Commission's progress threatens to be undone by several decisions that will delay or destroy the development of unlicensed PCS. Apple respectfully urges the Commission to review these policies, and to adopt a comprehensive regulatory structure that will promote the prompt development of unlicensed PCS.

Respectfully submitted,

Apple Computer, Inc.



James F. Lovette
One Infinite Loop, MS : 301-4J
Cupertino, California 95014
(408) 974-1418

February 12, 1993

OF COUNSEL:
Henry Goldberg
GOLDBERG, GODLES, WIENER & WRIGHT
1229 19th Street, N.W.
Washington, D.C. 20036
(202) 429-4900

Appendix A
San Diego: A Comparison Of Sharing Assumptions

A. The Cox Study.

Cox Enterprises, Inc. filed a study of current spectrum utilization in the 1850-1990 MHz band in the San Diego Metropolitan area.[1] That study affords an opportunity to examine alternative methods of frequency usage.

The Cox study, carried out by Comsearch, investigated "the availability of spectrum for the development of PCS when all current microwave users remain in the band. . . ."[2] Cox stated that "[t]he study illustrates graphically the lack of available frequencies for PCS providers to deploy their services, particularly in downtown San Diego and other high demand areas. The adverse impact on PCS development of providing interference protection to all existing microwave licensees . . . is obvious."[3]

As Cox stated, the "study reveals numerous critical, high demand areas that PCS providers would be blocked from providing service. . . . There is simply not enough underutilized spectrum in the 1850-1990 MHz band to permit PCS providers to serve critical areas within their licensed markets without significant relocation of existing users."[4]

Cox found, in fact, that in light of the 24 microwave paths occupying the "120 MHz theoretically available for PCS licensees in the 1850-1990 MHz band, no frequencies are available in any of [the population centers within San Diego] for licensed PCS operation on a shared, non-interfering basis."[5] Further, Cox established that "[b]y moving all of the non-exempt microwave licenses [out of the band], only 30 to 40 MHz can be cleared."[6]

Cox has proffered these findings, among others, as evidence that "a 40 MHz minimum assignment of spectrum per licensee (with access to a spectrum reserve)" is required "based largely upon the need to design PCS systems that accommodate wideband incumbent microwave operators. . . ."[7] Cox's conclusions appear very similar to others', and Apple does not dispute them.

---

[1] The study was filed as part of Cox's Reply Comments in GEN Docket No. 90-314 (filed Jan. 8, 1993). Citations herein are to either those Reply Comments or to Cox's Comments in ET Docket No. 92-9 (filed Jan. 13, 1993), which summarized the more detailed earlier submission.

[2] Cox Comments at 4.

[3] Id.

[4] Id. at 4-5. Cox also references "[a]nother study conducted by American Personal Communications . . . [that] found comparable or worse blocking problems in the eleven largest metropolitan areas in the United States." Id. at 4 n.4.

[5] Cox Reply Comments, GEN Docket No. 90-314, at 6 and n.8.

[6] Id. at 6-7.

[7] Id. at 3.

While agreeing that Cox's evidence is convincing if its fundamental assumptions are not changed, Apple respectfully suggests that there may be alternative mitigations or solutions that relate the spectrum that must be allocated for the desired service more to the actual communications bandwidth required, rather than to the total required to provide for sharing as well. Permanently setting aside excess spectrum to satisfy a need that can be met by other means may not be the best course of action.

B. Apple's Study.

Apple has also examined the San Diego area, but applying different assumptions. Apple assumed that, in accord with practice, no party has reexamined overall frequency usage after individual installations were made to see how those assignments could now better be made.[8] Apple also assumed for the purposes of this study that each microwave link was capable of being retuned within the 1850-1990 MHz band.[9]

Further assumptions by Apple, for the sake of this examination, included accepting the interference criteria of TSB 10E, not challenging common practice in adhering to duplex-split and adjacent-channel ground rules, and judging that any link now occupying a 5 MHz interstitial channel could be accommodated in a 10 MHz channel.

What Apple found provided a very different outlook. By employing the optimization methodology proposed by Apple and developed by the telecommunications consulting firm of Rubin, Bednarek and Associates, Washington, D.C., the 26 San Diego paths could be accommodated in 90 MHz of the 140 MHz available, thus freeing 50 MHz completely.[10] Of even more interest, four paths were identified that each individually blocked a different 10 MHz channel; moving each of these out of the band would free an additional 10 MHz, or a total of 40 MHz. Thus, by relocating four paths, all remaining paths

---

[8] In fact, it is not possible to perform frequency optimization in advance of knowing all the requirements for all the stations, including the required sites for transmitters and receivers. Optimization can only be performed when those details, the goals of the optimization, and the constraints upon it, are known.

[9] Apple recognizes that this latter assumption is not always valid and that retuning may be physically trivial in some cases and extremely difficult in others. While most equipment is capable of such retuning given the right circumstances, there may be practical difficulties, both administrative and technical, of doing so, particularly in the field and without interfering with service. Even in such cases, this task must be compared with the alternatives. These considerations are on a case-by-case basis and should not invalidate the value of selectively applying this methodology.

[10] In San Diego and elsewhere, the exact selection of the geographical area for study, and the resulting count of paths, may vary from study to study. For example, Apple's examination included two more paths in the San Diego area than did Cox's.

could be accommodated using only 50 MHz, and the other 90 MHz could be completely cleared.[11]

Apple emphasizes that the frequencies thus freed in San Diego are the same channels throughout that area; there is no spotty array with different frequencies available in different areas. This suggests that "avoidance" schemes that use different frequencies in different local areas would not be required in order to enjoy access to all 90 MHz.

The precise way that these 50 MHz, or these 90 MHz, could be used to benefit unlicensed PCS, or licensed PCS under any number of allocation schemes, is not the object of Apple's comments herewith; more than likely, it would be appropriate to allocate some of the freed spectrum for each category of service. Nor is it Apple's point to undermine the value or validity of Cox's findings. However, Apple's findings suggest that in many cases, there can be advantages to assuming something other than the *status quo.*

It would be improper to extrapolate the San Diego case nationwide, or to fail to examine the many special cases of links that cannot conveniently be retuned. However, Apple has found similar potential in four other market areas it has studied.

- In Cleveland, the 99 paths now occupying 140 MHz could be accommodated in 110 MHz. Moreover, if 6 paths were moved out of the band, a total of 60 MHz could be cleared.

- In Houston, the 129 paths now occupying 140 MHz require all 140 MHz even after channel optimization. However, if 7 paths were then moved out of the band, a total of 60 MHz could be cleared.

- In Baltimore/Washington, the 101 paths now occupying 140 MHz could be accommodated in 130 MHz. If 5 paths were moved out of the band, a total of 40 MHz could be cleared; moving an additional 3 paths would free an additional 10 MHz.

- In San Francisco, the 122 paths now occupying 140 MHz could be accommodated in 120 MHz. If 4 paths were moved out of the band, a total of 60 MHz could be cleared.

Among the findings of interest is that Apple's methodology provides for clearing the same frequencies nationwide. Some of these cleared frequencies could be designated for unlicensed operation so that nationwide deployment of unlicensed services could begin promptly.

---

[11] By comparison and as cited above, the Cox study scenario showed that removing 14 particular paths would free a total of "only 30 to 40 MHz."

In choosing its four initial study areas, Apple selected some of the more densely populated microwave regions.[12] Even so, retuning the total number of paths that require relocation to present a reasonable environment for both unlicensed and licensed PCS is not nearly as onerous as moving all of those paths to 6 GHz. San Diego, with less congestion, may be more representative of medium markets, where the scale of the task is much less daunting. It may also be possible to predict that a very high percentage of paths nationwide would never have to be moved out of the existing band if their frequency usage were optimized.

Apple developed its frequency optimization approach with the objective of reducing, without expecting to eliminate, the tasks ahead, particularly those related to the troublesome timetable for mass migration of microwave facilities to 6 GHz. In all likelihood, frequency optimization techniques such as this one would be most effective if employed as a later (or even last) resort, to be applied to stations not able to relocate to 6 GHz in a timely fashion. A combination of transition options, capable of addressing a variety of circumstances, could be most effective.

---

[12] It appears unlikely that Apple's optimization methodology would be of much value in Los Angeles, where congestion has required continuing efforts to obtain any frequencies at all.